THE TREATMENT OF MUSCULAR PARESIS BY MEANS OF ECCENTRIC MOVEMENTS.

BY

RODOLPH ABERCROMBIE, M.D.CANTAB., M.R.C.S., L.R.C.P.,

MEDICAL DIRECTOR, EDGAR ALLEN INSTITUTE, SHEFFIELD.

THE treatment of conditions of muscular paresis by means of the so-called eccentric movements originated in Sweden; though widely used in Scandinavia and Germany, it is apparently little known in England.

The terms "eccentric" and "concentric" as applied to muscular movements are rather clumsy; but it is necessary to adhere to them, because they are in general use on the Continent. By a "concentric movement" is meant the ordinary movement of a muscle which does work while *becoming shorter;* on the other hand, a muscle is said to perform an "eccentric movement" when it does work while *becoming longer.* The significance of the terms arises from the fact that during concentric movements the ends of the muscle approximate more nearly to the muscle's central point; while during eccentric movements they become more widely separated from it.

To take a simple example: if a patient flexes his arm at the elbow-joint by means of his biceps, the biceps performs a concentric movement, for it does work while becoming shorter. If now a manipulator grasps the wrist of the patient's flexed arm, and gradually extends the arm at the elbow-joint while the patient resists the extension, the biceps performs an eccentric movement; for in resisting the extension at the elbow-joint, the biceps does work while becoming gradually longer.

The general rule for the performance of eccentric movements is that the manipulator first puts the muscle into its shortest position, and then gradually elongates it, while the patient resists the elongation.

In England, concentric movements are almost exclusively used in the treatment of paresis, the use of eccentric movements being very little known.

Paresis after Fracture.

The following case, however, shows that the little-used eccentric movements may be of far more value than the more ordinarily used concentric movements.

H. M., aged 11 years, suffering from wrist-drop due to fracture of the lower end of the humerus eight weeks previously. Callus, which had obviously interfered with the musculo-spiral nerve, was to be felt at the seat of fracture. The paralysis had been treated for four weeks, without effect, by means of electrical treatment and massage, and the limb had been splinted with the hand in the hyperextended position.

At the commencement of the treatment by eccentric movements the paralysis of the extensors of the wrist appeared at first sight to be complete. The hand hung limply in the position of extreme flexion; the extensors of the wrist were overstretched, and the power of raising the hand was completely lost. In such a case exercise of the extensors by the ordinary concentric movements was obviously impossible; the boy could not begin to raise his hand, so could not initiate the movement. Eccentric movements were here of high value. These were performed in the following manner: The manipulator first grasped the boy's hand, and raised it into the position of full extension, thus putting the extensors of the wrist into the shortest position; the manipulator then gradually and slowly allowed the hand to sink into the position of flexion, at the same time urging the patient to delay the fall of the hand. The hand did not fall completely "dead," thus showing that the extensors, when put into the shortest position, possessed a trace of contractile power in the way of resisting elongation, although in their overstretched position they had seemed quite powerless.

By repeating the described manœuvre, it was possible to exercise the extensors, with the result that rapid daily improvement took place, so that by the end of ten days the boy could hold his hand in a horizontal position. Thus treatment by eccentric movements for ten days produced a more marked effect than one month's previous treatment by massage, electrical treatment, and splinting in the hyperextended position.

At this stage the extensors were exercised somewhat differently. The boy held his hand in a horizontal position, and the manipulator pressed it down into the position of flexion, while the boy resisted the movement. Complete recovery of the power of the extensors took place more slowly, occupying several weeks, but was ultimately complete.

The above case illustrates the advantages of treatment by eccentric movements. In the first place, they enable the muscles to be exercised while still too weak to raise the weight of the limb; in the second place, it will frequently be found that a muscle which in the overstretched position appears quite powerless may yet, if put into its shortest position, give evidence of undoubted power in the way of resisting elongation. The concentric movements ordinarily performed bring the muscle into action in its longest or overstretched, and therefore least favourable, position; eccentric movements, on the other hand, bring the muscle into play in its shortest, and therefore favourable, position. Thus, by their means, it is possible to exercise a paretic muscle at the earliest possible moment, when it possesses only the smallest trace of contractile power. Herein lies the value of this treatment, for if a muscle can be got to contract physiologically, however feebly, the restoration of function will be far more rapid than can be brought about by merely passive manipulations.

In the case of wrist-drop just described, the delay in recovery was clearly not due to the continued pressure of the callus on the nerve, but was caused by some change in the muscles themselves, which was a sequel of that pressure, for it was only necessary to exercise the muscles for rapid recovery to take place.

Anterior Poliomyelitis.

In the treatment of the results of anterior poliomyelitis eccentric movements are of great service. It may be of interest, for the sake of contrast, to quote the description of the method usually employed in England, as given by Mr. Tubby:[1]

> When there is footdrop, or paralysis of the dorsiflexors, the attendant may gently press his hand against the sole, and encourage the patient to dorsiflex the foot.

It will be noticed that what is described is a concentric movement; it is open to the objection that in a severe case the movement could not be carried out because the paretic extensors would not be strong enough to raise the weight of the foot, and thus the patient could not initiate the movement. In such a severe case the value of eccentric movements would be evident, for by their means the extensors could be exercised long before they were strong enough to raise the weight of the foot. To perform them the manipulator would first bring the foot into a position of extreme dorsiflexion, thus putting the paretic muscles into their shortest position; he would then gradually allow the foot to drop, while the patient attempted to delay the fall of the foot. By this means even the smallest trace of contractile power could be utilized, and the muscles could be exercised at an earlier date—often many months earlier—than would be possible by the method followed in England.

Other affected muscles are dealt with on a similar plan. I frequently see cases of this condition, which had been treated without avail by massage and electricity, improve considerably under eccentric movements. It is worth noting that treatment by eccentric movements takes far less time each day than electrical treatment or massage—a matter of importance when numbers of patients have to be dealt with. All three methods may be well used in conjunction.

Facial Paralysis.

In facial paralysis a similar method is followed. In dealing with the muscles of expression, the manipulator first draws the affected muscle into its shortest position, and the patient attempts to hold it there, and this manœuvre is repeated. If, owing to paresis of the orbicularis, the eye can only be partially closed, the manipulator first draws the upper lid fully down by means of the forefinger; he then removes his forefinger, and the patient endeavours to delay the opening of the eye. Later, when the orbicularis possesses more power, the lid is first closed, and the manipulator then draws it gently upwards with the forefinger, while the patient resists the movement. Even in old-standing cases, this treatment is sometimes successful.

Paresis of the Upper Limb.

In treating the paresis of the deltoid which so often follows injuries to the shoulder, the manipulator first raises the affected arm to the horizontal; he then supports the arm by placing his hand under the patient's wrist; the manipulator then gradually lowers the arm, while the

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patient endeavours to delay its fall. By this means the deltoid may be exercised while still too weak to raise the arm from the side.

Paresis of the short muscles of the hand and of the flexors of the fingers provide suitable cases for this form of treatment. As before, the muscles are first put into their shortest position and then elongated, while the patient resists the extension.

Mode of Application.

The question as to how often the movements should be performed is of importance. They should be performed from five to ten times at each sitting, and the sittings may be given once or twice daily. A common mistake is to exercise paretic muscles too frequently. If this is done, the muscles become exhausted and recovery is retarded, not hastened. The manœuvres must be performed slowly and carefully with a strength proportionate to the muscle's power.

The results obtained will obviously depend largely on the nature and causation of the paresis. In general terms, cases of lower-segment paralysis are better suited to this form of treatment than cases of upper-segment paralysis. In order that the treatment may be of benefit, the affected muscles must not be absolutely paralysed, but must possess some trace of contractile power. But it must be remembered that a muscle, which in its over-stretched position may appear absolutely paralysed, may yet possess latent contractile power which may be obvious in its shortest position. In general terms, it may be said that if a muscle possesses any contractile power at all, that power may be increased by the persevering use of eccentric movements. This holds good even in long-standing cases; in such cases possibly the result is obtained by the hypertrophy of individual muscle fibres.

As mentioned before, treatment by eccentric movements may well be used in conjunction with electrical treatment and massage. Percussions and vibrations may also be used, and in certain cases the limb may be splinted so as to prevent over-stretching of the affected muscles. The writer, however, considers that eccentric movements are the most valuable single measure in the treatment of paresis.

Theoretical Explanations.

I suggest that an explanation of the above phenomena is to be found in the microscopic structure of striped muscle fibre. Schäfer's[2] views on the histology of muscle are here followed, but are only given in bare outline; the division of the muscle fibre into sarcostyles and sarcomeres is omitted as not essential to the present question.

A striated muscle consists of fibres each of which is marked by transverse bands of alternate light and dark material. According to Schäfer, the dark bands are made up of longitudinal channels or tubules arranged parallel with the long axis of the muscle fibre. Each such channel or tubule is closed at one end (line of Hensen), but at its other end opens by means of a minute pore towards the light band, which is composed of clear translucent material. In Schäfer's view, when the muscle contracts, the translucent material of the light band flows or is drawn into the channels of the dark band, and becomes hidden from view. By this means each individual channel of the dark band becomes shorter and wider, and by the sum of similar processes shortening and widening of the muscle fibre occurs. The evil effects of over-stretching on a muscle may now be considered in the light of this minute structure.

Mr. Robert Jones[3] has recently emphasized the injurious effects of over-stretching. He suggests that it has the effect of causing the nerve cells to become inactive, though not extinct. I put forward the view that the evil effects of over-stretching have nothing to do with the nervous apparatus of the muscle, but have their origin in certain changes produced by the stretching on the muscle itself.

When a muscle fibre is over-stretched its sheath (sarcolemma) is brought into a state of tension, causing lateral compression of its contents. By this lateral compression the longitudinal channels which compose the dark bands will be compressed one against the other, and this will have the effect of obstructing the orifices of the minute pores through which the translucent material gains entrance to the channels. This affords a simple mechanical explanation of the ill effects of over-stretching; for since the ingress of the translucent material into the channels of the dark band is impeded, so also will physiological contraction of the muscle be hindered or prevented, even though the nervous mechanism of the muscle may be intact.

The same considerations explain why a muscle, which appears functionless when over-stretched, can yet exhibit contractile power when put into its shortest position; for in the latter position the sheath of the muscle fibre is relaxed, the channels of the dark band do not press on one another, and therefore their pores will be unobstructed and the ingress of the translucent material easy.

It will also be clear why physiological contraction is so important in the treatment of paresis, for it is the only means of causing ingress and egress of the translucent material to and from the channels, passive manipulations being powerless to effect this. The rapid improvement that sometimes takes place in a paretic muscle as the result of exercise (as in the case of wrist-drop quoted above) may be explained by supposing that through disuse the entrances to the channels may become clogged, and possibly the translucent material altered in consistence. A few physiological contractions may serve to clear the entrance to the channels, and thus bring about rapid improvement in the muscle's power.

CONCLUSIONS.

1. In order to perform eccentric movements, the manipulator first brings the affected muscle into its shortest position and then gradually elongates it, while the patient resists the elongation.

2. Such movements are of more value in the treatment of paresis than the more ordinarily employed muscular movements.

3. The explanation of the effect of such movements is to be found in the microscopic structure of striped muscle.

REFERENCES.

[1] Tubby, *Deformities, including Diseases of the Bones and Joints*, vol. ii, p. 615. [2] *Gray's Anatomy*, seventh edition, p. 38. [3] Robert Jones, BRITISH MEDICAL JOURNAL, December 9th, 1911, p. 1520.

RAYNAUD'S SYNDROME AND SYPHILIS.

BY

HENRY SEMON, M.D., M.R.C.P.,

SENIOR ASSISTANT, DERMATOLOGICAL DEPARTMENT, UNIVERSITY COLLEGE HOSPITAL.

IT would appear that Sir Jonathan Hutchinson was the first to call attention to the relation of syphilis to certain cases of Raynaud's disease,[1] so that the idea of their possible association is by no means new. Since his paper (1889) there have been an ever-increasing number of reports of similar cases, and the occurrence of one in the out-patient department at the Great Northern Hospital, which Dr. Whitfield has kindly allowed me to make use of, and was the subject of an animated discussion at the Dermatological Section of the Royal Society of Medicine,[2] must be my excuse for once more calling attention to the importance of recognizing not only the syndrome which Raynaud described, but still more to the vital necessity, from the patient's point of view, of tracing to its ultimate cause or causes the etiology of the condition.

Inasmuch as the physician has in a majority of cases only the clinical evidence to go upon, it would be better to look upon Raynaud's disease, not as a disease *sui generis*—a tendency which is undoubtedly still generally prevalent—but rather as an associated clinical picture, a symptom complex, dependent, perhaps, on a variety of factors in which the angiospastic conception of Raynaud plays only a part, and for which some organic and structural change of the vascular system concerned is mainly responsible.

The case referred to is that of a woman aged 56, who has suffered for over seven years from symptoms which Raynaud would have called typical, and which in the present attack have terminated in gangrene (of the dry type) of the tips of the thumb, first, fourth, and little fingers of the left hand, due to local syncope as evidenced by cyanosis of the third left finger, and of the digits of the right hand. In none of these situations is more than the pulp of the distal phalanx involved, and the

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